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HIGHWAY RESEARCH REPORT

Study of Lime Treated Sections on Road 10-SJ-580,132

68-66

STATE OF CALIFORNIA

TRANSPORTATION AGENCY

DEPARTMENT OF PUBLIC WORKS

DIVISION OF HIGHWAYS

MATERIALS AND RESEARCH DEPARTMENT

RESEARCH REPORT

NO. M & R 633189

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STATE OF CALIFORNIA
Department of Public Works
Division of Highways
Materials and Research Department
Sacramento, California

February 1, 1968

Lab. Auth. No. 633189

Mr. J. A. Legarra
State Highway Engineer

Dear Sir:

Submitted for your consideration is:

A REPORT ON

STUDY OF LIME TREATED

SECTIONS ON ROAD

10-SJ-580,132

NEAR TRACY, CALIFORNIA

ERNEST ZUBE
Principal Investigator

CLYDE GATES AND MAS HATANO
Co-Investigators

Very truly yours,

JOHN L. BEATON
Materials and Research Engineer

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REFERENCE: Zube, E., Gates, C.G. and Hatano, M., "Study of Lime Treated Sections on Road 10-SJ-580,132", State of California, Department of Public Works, Division of Highways, Materials and Research Department. Research Report 633189, February 1, 1968.

ABSTRACT: This study was made to determine the effectiveness of the use of lime for treating expansive clay soils under portland cement concrete pavements to minimize slab distortion or curl caused by moisture differentials in the clay basement soil.

Several short experimental sections were constructed by lime treating the expansive clay soil and reducing the cover requirements. The lime treated layer formed a relatively moisture resistant layer that prevented water that entered through open joints from concentrating in the basement soil near the joint. The treated layer also permitted capillary moisture to accumulate in a uniform manner.

This project indicates that lime treatment is a feasible method of minimizing portland cement concrete pavement curl due to expansive soils.

KEY WORDS: Soils, soil moisture, soil stabilization, soil testing, lime, liming of soils, portland cement concretes, pavement, slabs, distortion/structural, rigid pavement, riding quality, nuclear moisture-density determination.

This work was done in cooperation with the U.S. Department of Transportation, Federal Highway Administration, Bureau of Public Roads, and their cooperation is hereby acknowledged. The opinions, findings and conclusions expressed in this publication are those of the authors and not necessarily those of the Bureau of Public Roads.

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INTRODUCTION

Portland cement concrete pavement (PCCP) slabs can become severely distorted as a direct consequence of differential expansion in the underlying clay soil if proper preventive measures are not taken. Surface water during rainy weather penetrates through contraction joints that open shortly after construction and enter the underlying expansive clay soils at these joints in concentrated amounts causing differential swell of the expansive soils, thereby raising the joints. Slab distortion or curl also occurs due to temperature changes, shrinkage characteristics of the aggregate and moisture conditions in the slab. These variables may act together or oppose each other which would influence the amount of curl which occurs. This report deals only with slab distortion due to expansive soils.

In 1954, a State highway located near San Jose, California, experienced severe PCCP curl due to expansive soils. Differences in elevation of over 3/4" were recorded between joints and midslab. This curl phenomena is thoroughly covered in a report published in 1954.[1]

At the present time, California uses Test Method No. Calif. 354[2] for designing the structural section of PCCP over expansive clay soils. This method utilizes moisture control and weight of cover to minimize slab distortion due to expansive subsoils. In many areas of the State, cover requirements of three and four feet with moisture control are needed.

Prior experiments using lime for treating clay soils indicated the following beneficial results:

1. Increase in strength of the treated soil.

2. Expansion pressure is reduced to a negligible amount.

3. The lime treated layer forms a relatively impermeable layer against moisture intrusion. Any water that comes through the open joints of the pavement would not be concentrated in a localized area in the basement soil. In addition, the lime treated layer would help raise the moisture content of the basement soil in a uniform manner by moisture capillarity.

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Due to this experience, it was believed that lime treatment of the expansive clay soil under PCCP would permit reduction of the structural section thickness and minimize the magnitude of slab distortion due to differential volume change of the clay soil by preventing a concentration of moistures in the underlying clay soils near the joints and edges of the pavement.

Road 10-SJ-580,132 (near Tracy) by standard design criteria, required three to four feet of cover to control PCCP curl. Lime treatment was used on the test sections and the structural section was reduced to 2.5 feet. This report describes the use of lime for treating the expansive clay soil.

The test sections were planned so that the untreated control sections were adjacent to each lime treated section. Soil samples were obtained and tested during construction. After completion of the project, profilograph measurements, profile by engineer's level, and moisture readings were taken to evaluate the effectiveness of the lime treated sections.

South Dakota[3], Kansas[4], and Colorado[5], have used lime for treating the clay soils under PCCP and they reported that slab distortion had been virtually eliminated.

SUMMARY AND CONCLUSIONS

1. This study showed that the lime treated layer is acting as an effective moisture barrier by preventing surface water from entering the basement soil.

2. The lime treated layer is also acting as an effective moisture barrier by permitting the underlying basement soil to reach ultimate moisture content in a uniform manner within five months thus preventing differential lifting of the PCC pavement between joints and midslab. After the basement soil reached ultimate moisture content, the lime treated layer kept the moisture content in the basement soil from undergoing seasonal changes.

3. The profile index of the completed portland cement concrete pavement is rather high for all sections, including the lime treated sections. However, there is no

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evidence of raised joints due to differential expansion of the basement soil which might be attributed to water getting through the weakened plane joints.

4. This study indicates that lime treatment can be used successfully to prevent PCC pavement curl normally associated with expansive basement soils.

DESCRIPTION OF PROJECT

This study was performed on Road 10-SJ-580,132 which is located in San Joaquin County near Tracy, California and is near the foothills of the Diablo Mountain Range (Figure 1).

The preliminary soils investigation indicated cover requirements of three to four feet of PCCP structural section with moisture control in the basement soil to prevent slab distortion over portions of this road.

The road is about 7.5 miles in length and is a four-lane freeway. This report covers that portion of the project that lies between Station 205+00 and 280+00. (Figure 2). The experimental and control structural section consists of 0.75' PCCP, 0.33' Class A cement treated base (CTB), 0.17' aggregate base (AB), 0.75' aggregate subbase (AS), and 0.50' of lime treated basement soil or 1.00' or 2.00' of imported borrow material.

MATERIALS AND CONSTRUCTION

Basement Soil The clay basement soils between Stations 205 and 280 varied considerably with respect to their volume change potential. Table I shows the location, grading, PI, and R-values on untreated and lime treated soils.

Imported Borrow The imported borrow material was obtained from the site of the proposed California aqueduct about a mile away. The material is a silty clay which was slightly expansive. Test data for two samples is shown on Table II.

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TABLE I

Road 10-SJ-110-A,A NBL #1

Sample No.	Location	Hydro Analysis PI	#4	#30	#200	5M	1M	Untr R-value	After Treating with 3% Lime R-value
64-3897	212+50	29	100	99	95	41	25	5	84
3898	"	32	100	99	94	47	30	8	
3907	217+00	29	100	99	96	43	24	7	85
3904	"	34	100	99	96	42	Floc	11	
3902	222+50	22	99	96	84	41	25		
3916	"	18	91	83	68	28	16		
3909	224+50	31	100	99	95	36	17	7	
3913	230+00	17	83	79	62	26	14		
3924	234+00	25	97	94	83	37	25		
3915	236+00	27	97	93	84	40	25	6	
3923	239+50	25	97	93	83	40	Floc		
3917	243+00	32	100	98	94	40	Floc	10	82
3919	246+00	16	99	95	58	39	17		
3920	248+50	8	99	97	65	22	12		
3903	252+50	10	96	90	67	22	12		
3921	"	5	100	98	69	17	9		
3900	257+50	11	99	97	81	26	14		
3899	"	9	100	99	81	25	15		
3922	261+50	17	80	67	48	22	15		
3918	"	14	90	79	55	23	14		
3911	262+50	29	88	77	63	34	15		
3912	269+00	32	98	89	81	45	27	9	85

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TABLE I Continued

Road 10-SJ-110-A,A SBL #1

Sample No.	Location	Hydro Analysis PI	#4	#30	#200	5M	1M	Untr R-value	After Treating with 3% Lime R-value
64-3869	213+00	19	93	88	69	30	Floc		
3865	220+00	26	100	99	96	38	Floc	10	
3862	223+00	18	85	74	58	27	Floc		
3864	225+00	21	87	77	65	30	10		
3870	"	25	96	91	83	44	27		
3877	230+00	32	100	99	93	44	17	7	83
3873	"	37		100	95	45	Floc	12	
3880	234+00	21	91	86	72	34	16		
3874	"	24	100	99	67	21	11		
3868	237+00	26	99	96	86	49	Floc		
3863	"	29	100	98	90	53	Floc	9	88
3875	240+50	33	100	97	92	46	28	15	66
3871	"	27	100	97	91	46	21		
3872	243+00	27	100	99	95	44	19		
3876	"	23		100	96	44	15		
3867	247+00	28	100	99	93	48	30	7	71
3879	"	29	100	99	93	45	Floc		
3878	249+50	7	100	98	59	18	8		
3866	"	12	100	99	82	30	12		
3914	252+50	6	100	99	66	19	11		
3906	256+00	10	100	99	88	26	14		
3901	261+50	13	82	70	51	21	16		
3908	266+00	4	86	77	57	14	5		
3905	272+00	11	43	26	12	4	3		
3910	275+00	26	96	91	81	43	14		

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TABLE II

Imported Borrow NBL #1 & SBL #1

Sample No.		Station	Hydro Analysis						Untreated R-value
			PI	#4	#30	#200	5M	1M	
64-4042	NBL	227+00	17	94	87	55	23	14	11
64-4049	SBL	220+00		96	90	55	22	13	17

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Lime Treatment (LT) The basement soil of the experimental sections was treated with 4% hydrated lime. One section in the southbound lane from Station 224 to 251 was treated in October of 1964. Heavy rains fell the day after the mix was compacted and sealed with 0.25 gallons per square yard of MC-250. The moisture content of the lime treated mix was around 32% during construction. The weather was warm and sunny for extended periods during the next six months but there were also periods of very heavy rainfall totaling about 16 incnes. A visit to the project in March 1965, indicated cracking throughout the lime treated portion of the roadway. This is illustrated in Figure 3A. Moisture samples taken in the lime treated layer six months after construction indicated varying moisture from about 16 to 32%. The moisture in the untreated basement soil, beneath the lime treatment, was also quite varied and much lower in most cases. It is believed that this was due to the difference in material and in moisture content of the cut or fill sections.

The cracking was probably due to drying and consequent shrinking of the lime treated material. As a comparison, Figure 3B shows cracking in the native soil. The extensive cracks indicate the clayey nature of the soil. The northbound lanes were also treated with 4% lime at a moisture content of about 32%. It was not known if this section also cracked since the subbase layer was placed shortly after the lime treatment. This work was performed during March, 1965.

Subbase Material The subbase material was furnished by the Pacific Coast Aggregate plant near Tracy. It conformed to the Class 2 requirement of the 1964 Standard Specifications. Generally, the aggregates had around a 70 to 80 R-value and had less than 10% passing the number 200 sieve. The maximum size aggregate was 2-1/2 inches.

Base and Cement Treated Base. The aggregate used for the untreated base came from the same source as the subbase material. The material was 3/4" maximum size. The cement treated base was constructed with 4% cement.

Portland Cement Concrete Pavement The aggregate came from the same source as the subbase material. A five-sack mix was used for the pavement. A slip form paving machine placed 24 feet of pavement in one pass.

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The aggregates from this source possess high shrinkage characteristics[6]. This causes curling in the concrete pavement when a moisture differential develops between the top and bottom of the slab. Temperature differentials also cause slab curl but this tends to be more of a daily or seasonal variation.

NUCLEAR INSTALLATIONS FOR MOISTURE DETERMINATIONS A nuclear method, described on page 8 of this report, was used for determining moisture variations in the layers of the structural sections. This eliminated the need for cutting numerous cores in the PCC pavement.

Sixteen locations in the untreated and treated sections were selected for installation of access tubes for determination of in-place moisture with a nuclear device. Eight locations were placed near midslab with the remaining eight placed near the adjacent sawed joints.

The following Table III shows the locations of the 16 installations.

TABLE III

LIME TREATED SECTIONS

Station 217+45	Northbound	outer	lane	Midslab
Station 217+54	"	"	"	Joint
Station 254+33	"	"	"	Midslab
Station 254+42	"	"	"	Joint
Station 227+25	Southbound	"	"	Midslab
Station 227+16	"	"	"	Joint
Station 235+70	"	"	"	Midslab
Station 235+61	"	"	"	Joint

UNTREATED SECTIONS

Station 225+08	Northbound	outer	lane	Midslab
Station 225+17	"	"	"	Joint
Station 242+66	"	"	"	Midslab
Station 242+75	"	"	"	Joint
Station 217+15	Southbound	"	"	Midslab
Station 217+06	"	"	"	Joint
Station 254+56	"	"	"	Midslab
Station 254+65	"	"	"	Joint

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Figure 4 shows the type of installations that were placed. Figure 5 shows the type of nuclear device used for making the moisture measurements.

Table IV shows the chronological data for construction operations, nuclear moisture determination and rainfall.

TABLE IV

CHRONOLOGICAL DATA

	Rainfall	
Summer & Fall of 1964	-----------	Earth Moving and Grading Operations
October 1964	0.95"	Lime Treatment completed between Stations 224 and 251 on the Southbound Lanes. (Before Rains)
November	1.52"	
December	2.29"	
January 1965	1.28"	
February	0.47"	
March	1.36"	Lime Treatment completed between Stations 210 and 224 and 251 and 271 on the Northbound Lanes.
April	2.06"	Imported Borrow placed
May	0	Aggregate Subbase placed
June	0	Cement Treated Base placed
July	0.22"	
August	0.31"	
September	0	Portland Cement Concrete placed
October	0.03"	
November	2.84"	Installations for Nuclear Determinations completed and Initial Readings made before Rains.
December	1.66"	
January 1966	0.98"	
February	1.06"	
March	0.14"	Nuclear Determinations for Moisture
April	0.34"	
May	0.09"	
June	0.09"	
July	0.23"	

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	Rainfall	
August	0	
September	0	
October	0	
November	1.69"	Nuclear Determinations for Moisture

ANALYSIS OF DATA ON MOISTURE DETERMINATIONS

Tables V, VI and VII show the moisture content of the roadbed at various depths below profile grade taken in November 1965, March 1966, and October 1966, for both the lime treated and the untreated control sections.

Figures 6, 7, and 8 show average moisture contents at selected depths taken from Tables V, VI, and VII. These figures indicate the following:

1. The aggregate subbase in the lime treated section (Figure 6) shows a much higher moisture content than in the untreated control sections (Figures 7 and 8). This indicates that the lime treated layer is acting as an effective moisture barrier and preventing the surface water from entering the basement soil.

2. The moisture content at the joints and midslab generally show an increase from the November 1965 to the March 1966 readings. The readings between March and October 1966 indicate a general moisture equilibrium condition has occurred and the change in moisture for joint and midslab parallel each other. This shows that the moisture contents of the basement soils increased almost equally under the joints and midslab of the PCC pavement and then did not undergo seasonal moisture changes. Therefore, there should be no differential rise in pavement between joint and midslab, due to expansive basement soils.

3. The basement soil moistures are considerably higher in the lime treated section than in the untreated control section. It is believed that this is due to the moisture vapor condensation phenomena that is occurring under the relatively impermeable lime treated layer. This is a desirable feature of lime treatment since uniform elevation of moisture in the basement soil minimizes PCCP curl or distortion

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due to differential swelling. This phenomena does not occur in the untreated control sections since there is a 12" permeable layer of aggregate subbase directly over the fine grained imported borrow and basement soil.

PRINCIPLES OF OPERATION OF THE NUCLEAR DEVICE FOR MOISTURE DETERMINATION

The model P-19 subsurface moisture probe is designed primarily for measuring moisture in soils at depths from the surface to 200 feet below the surface.

The device contains a radiation source which produces fast neutrons and a detector which is only sensitive to slow neutrons. Hydrogen in the moisture contained in the soil is responsible for changing the fast neutrons to slow neutrons. A calibration curve is used to interpret the relationship between the counting rate and relative moisture concentration.

The moisture probe provides measurements which are accurate within ± 2% moisture.

The probe may be operated in a temperature range of -20F to +130F in any normal density soil.

PROFILOGRAPH MEASUREMENTS

Initial profilograph measurements were made on the road about two months after the paving was completed. The California truck-mounted profilograph was used to make the measurements (Figure 9).

The contract specifications set a maximum Profile Index[7] of 7.0 inches per mile with no bumps exceeding 0.3 inches. Some areas had to be ground to meet this requirement. Profile measurements were made after grinding. The following Table VIII shows the Profile Index values for the various sections.

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TABLE VIII

Station	Type of Section	Profile Index 12/28/65	Profile Index 6/16/66
	North Roadbed		
251-271	Lime	5.7	9.4
230-251	1.0 IB	4.9	7.0
224-230	2.0 IB	3.2	5.2
211-224	Lime	4.6	9.1
	South Roadbed		
211-224	2.0 IB	5.0	5.9
224-251	Lime	6.1	11.5
251-274	1.0 IB	1.5	1.8

The profile index taken on December 28, 1965 shortly after the PCC pavement was placed, showed fairly high values. For some unexplainable reason, the lime treated sections showed the highest values. The profile index taken six months later on June 16, 1966, showed increases for all sections. Since the profilograph measures all surface roughness, it was decided to take profiles at locations of high values with an engineer's level to determine the type of roughness. Figures 10 and 11 show the plots of the measurements. While there are a few high joints, they appear to be peaks in the grade and not curled slabs. Therefore, the roughness must be attributable to some other cause than moisture differential in the basement soil caused by water getting through joints in the PCC pavement.

The riding quality of the test sections is good with no perceptible bumps at the joints.

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TABLE V
MOISTURE DATA BY NUCLEAR GAGE
Road 10-SJ-110 NBL
Lime Treated Section
Percent Moisture

	Depth Below Profile Grade	217+45 Midslab 11-17-65	3-22-66	10-19-66	217+54 Joint 11-17-65	3-22-66	10-19-66
CTB	12"	8.5	8.2	7.6	9.2	8.9	8.1
AB	14"	8.6	8.1	7.1	9.4	8.8	7.6
AS	17"	9.7	8.8	7.1	14.4	9.5	7.7
AS	22"	18.4	19.2	16.8	18.8	19.9	16.4
LT	26"	25.4	28.2	27.7	23.3	25.5	24.2
LT	28"	24.2	27.9	28.1	23.9	26.9	25.4
Emb	32"	24.5	27.3	27.7	24.1	27.3	26.5
Emb	36"	25.3	28.1	27.2	22.5	26.5	25.3
Emb	48"	18.4	22.3	23.0	19.8	23.7	23.2
Emb	60"	24.3	27.3	26.7	22.2	26.2	25.1
Emb	72"	23.1	25.0	25.0	21.3	24.6	24.4

		254+33 Midslab 11-15-65	3-21-66	10-19-66	254+42 Joint 11-15-65	3-21-66	10-19-66
CTB	12"	9.0	8.0	7.8	9.2	9.2	8.6
AB	14"	9.1	8.2	7.9	9.6	8.8	8.5
AS	17"	11.2	12.2	9.9	10.9	10.9	8.9
AS	22"	17.9	17.9	17.8	18.2	18.6	17.6
LT	26"	15.3	15.9	17.0	16.1	16.2	16.9
LT	28"	13.6	14.2	14.4	15.2	15.0	14.3
Emb	32"	12.2	13.7	12.8	14.1	14.4	13.4
Emb	36"	10.0	11.6	11.0	12.5	13.1	11.5
Emb	48"	9.9	11.4	10.1	12.6	13.0	11.3
Emb	60"	12.4	12.7	12.3	12.7	14.2	13.2
Emb	72"	11.9	12.6	12.3	8.1	8.1	7.9

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TABLE V Continued
MOISTURE DATA BY NUCLEAR GAGE
Road 10-SJ-110 SBL
Lime Treated Section
Percent Moisture

	Depth Below Profile Grade	227+25	Midslab		227+16	Joint	
		11-17-65	3-22-66	10-19-66	11-17-65	3-22-66	10-19-66
CTB	12"	7.4	8.3	7.9	9.8	9.6	9.2
AB	14"	7.0	7.6	7.3	8.8	8.5	8.2
AS	17"	7.9	7.5	7.0	9.3	8.1	7.4
AS	22"	13.0	14.2	11.7	13.3	12.7	10.8
LT	26"	18.3	21.9	20.9	21.3	22.7	22.3
LT	28"	16.2	23.3	22.2	22.2	24.9	23.6
Emb	32"	16.7	24.3	23.4	19.5	24.8	24.7
Emb	36"	16.0	22.8	22.6	16.3	26.9	23.2
Emb	48"	17.4	24.1	24.0	17.2	25.8	25.6
Emb	60"	16.6	19.7	21.8	16.3	23.3	23.0
Emb	72"	18.5	19.6	23.3	18.3	21.3	24.0

		235+70	Midslab		235+61	Joint	
		11-17-65	3-22-66	10-19-66	11-17-65	3-22-66	10-19-66
CTB	12"	7.2	9.5	9.1	10.3	8.3	8.2
AB	14"	7.4	8.3	7.9	9.5	7.7	7.7
AS	17"	8.0	8.8	7.9	8.5	7.9	7.7
AS	22"	18.4	22.8	20.6	22.7	22.1	20.8
LT	26"	19.0	25.2	24.1	26.1	26.3	24.8
LT	28"	17.8	24.7	23.5	25.0	25.4	24.6
Emb	32"	16.9	24.5	23.7	21.9	24.2	24.1
Emb	36"	16.9	25.3	24.1	16.8	22.4	22.2
Emb	48"	15.6	23.3	21.5	15.0	20.1	20.3
Emb	60"	15.1	20.8	19.9	14.6	16.1	18.5
Emb	72"	16.5	17.7	18.9	16.8	17.3	19.0

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TABLE VI
MOISTURE DATA BY NUCLEAR GAGE
Road 10-SJ-110 SBL
Untreated Control Section 4' thick
Percent Moisture

	Depth Below Profile Grade	217+15 Midslab 11-17-65	3-22-66	10-19-66	217+06 Joint 11-17-65	3-22-66	10-19-66
CTB	12"	11.0	9.1	8.6	12.7	9.1	8.7
AB	14"	11.9	9.5	8.7	14.2	9.3	8.5
AS	17"	11.0	9.5	7.6	11.6	9.6	8.1
AS	22"	12.2	12.4	10.8	12.1	12.6	10.7
IB	26"	14.7	15.0	15.2	14.3	14.5	14.1
IB	33"	14.9	15.4	15.3	13.5	13.5	13.5
IB	39"	12.4	12.6	12.7	12.6	13.2	12.9
IB	46"	12.8	13.3	13.3	12.7	13.3	12.9
Emb	50"	17.3	17.9	17.7	17.4	18.1	18.1
Emb	60"	19.0	19.7	20.0	19.5	20.5	20.0
Emb	72"	20.0	20.9	21.3	21.2	21.3	21.6

		225+08 Midslab 11-16-65	3-22-66	10-19-66	225+17 Joint 11-16-65	3-22-66	10-19-66
CTB	12"	9.5	9.1	8.5	10.0	9.1	8.4
AB	14"	10.1	9.2	8.1	11.6	9.4	8.5
AS	17"	10.8	10.0	8.6	8.1	8.6	8.0
AS	22"	14.2	14.6	12.7	12.1	11.9	11.2
IB	26"	15.8	16.5	16.2	16.2	16.6	16.5
IB	33"	14.9	15.1	15.2	15.3	15.3	15.0
IB	39"	12.8	14.1	14.0	14.7	14.5	14.7
IB	46"	12.7	14.0	13.7	14.2	13.8	13.9
Emb	50"	15.1	16.4	16.1	15.7	15.9	17.4
Emb	60"	16.5	17.9	16.9	19.1	19.1	19.5
Emb	72"	17.3	17.8	16.6	17.6	19.7	22.1

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TABLE VII
MOISTURE DATA BY NUCLEAR GAGE
Road 10-SJ-110 NBL
Untreated Control Section 3' thick
Percent Moisture

	Depth Below Profile Grade	242+66 Midslab 11-16-65	3-21-66	10-19-66	242+75 Joint 11-16-65	3-21-66	10-19-66
CTB	12"	8.3	8.3	7.9	8.4	8.8	8.5
AB	14"	8.9	8.6	7.9	9.5	9.2	8.5
AS	17"	8.5	8.4	7.2	9.9	9.2	8.0
AS	22"	11.6	11.0	8.8	8.8	11.3	9.2
IB	26"	14.5	14.9	13.1	13.5	14.2	12.9
IB	30"	14.2	14.6	13.2	12.8	14.6	13.4
IB	34"	17.8	20.2	17.5	15.9	18.3	17.0
Emb	38"	21.7	22.2	22.2	16.8	19.7	19.8
Emb	48"	15.8	18.5	18.1	14.9	18.6	18.5
Emb	60"	17.1	17.9	18.5	13.1	13.6	15.8
Emb	72"	15.2	15.7	17.2	14.4	10.6	15.6

		254+56 Midslab 11-18-65	3-22-66	10-19-66	254+65 Joint 11-18-65	3-22-66	10-19-66
CTB	12"	7.5	9.5	9.0	9.4	9.6	9.3
AB	14"	7.2	9.1	8.3	8.8	8.4	8.4
AS	17"	7.1	8.7	7.3	8.5	7.7	7.5
AS	22"	9.0	11.5	10.2	10.9	10.0	8.8
IB	26"	12.4	13.7	11.2	12.7	13.2	11.9
IB	30"	13.1	13.6	12.2	12.7	13.5	12.1
IB	34"	13.1	13.6	13.1	12.3	13.7	12.5
Emb	38"	14.1	15.1	14.1	13.1	14.5	13.4
Emb	48"	14.6	18.3	15.3	16.7	16.0	14.7
Emb	60"	11.6	13.0	12.5	12.0	12.8	12.4
Emb	72"	13.1	12.9	14.0	12.0	14.0	12.6

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Figure 1

10 - SJ - 110 - A,B CONTRACT 65 - 10T13C058534

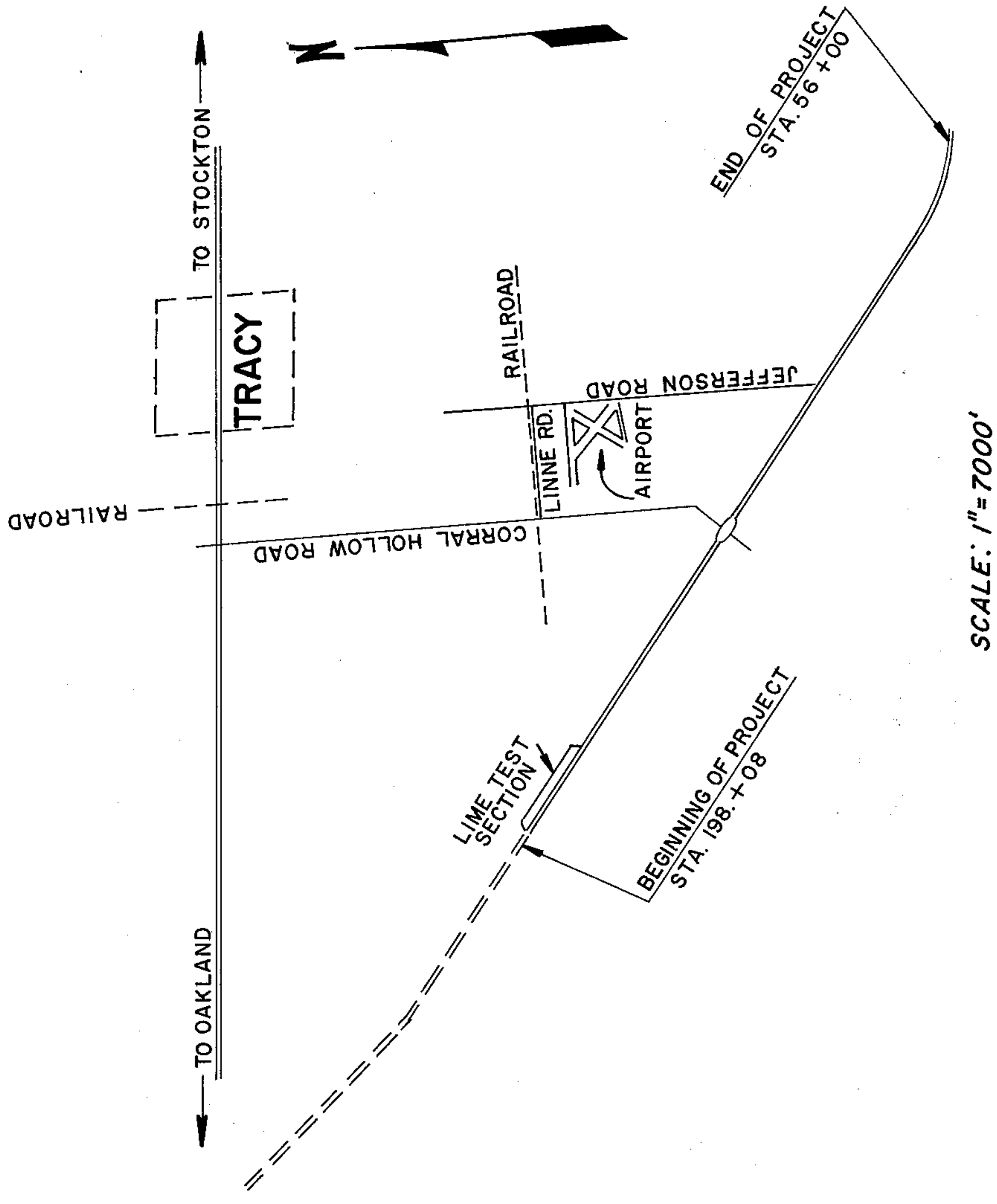

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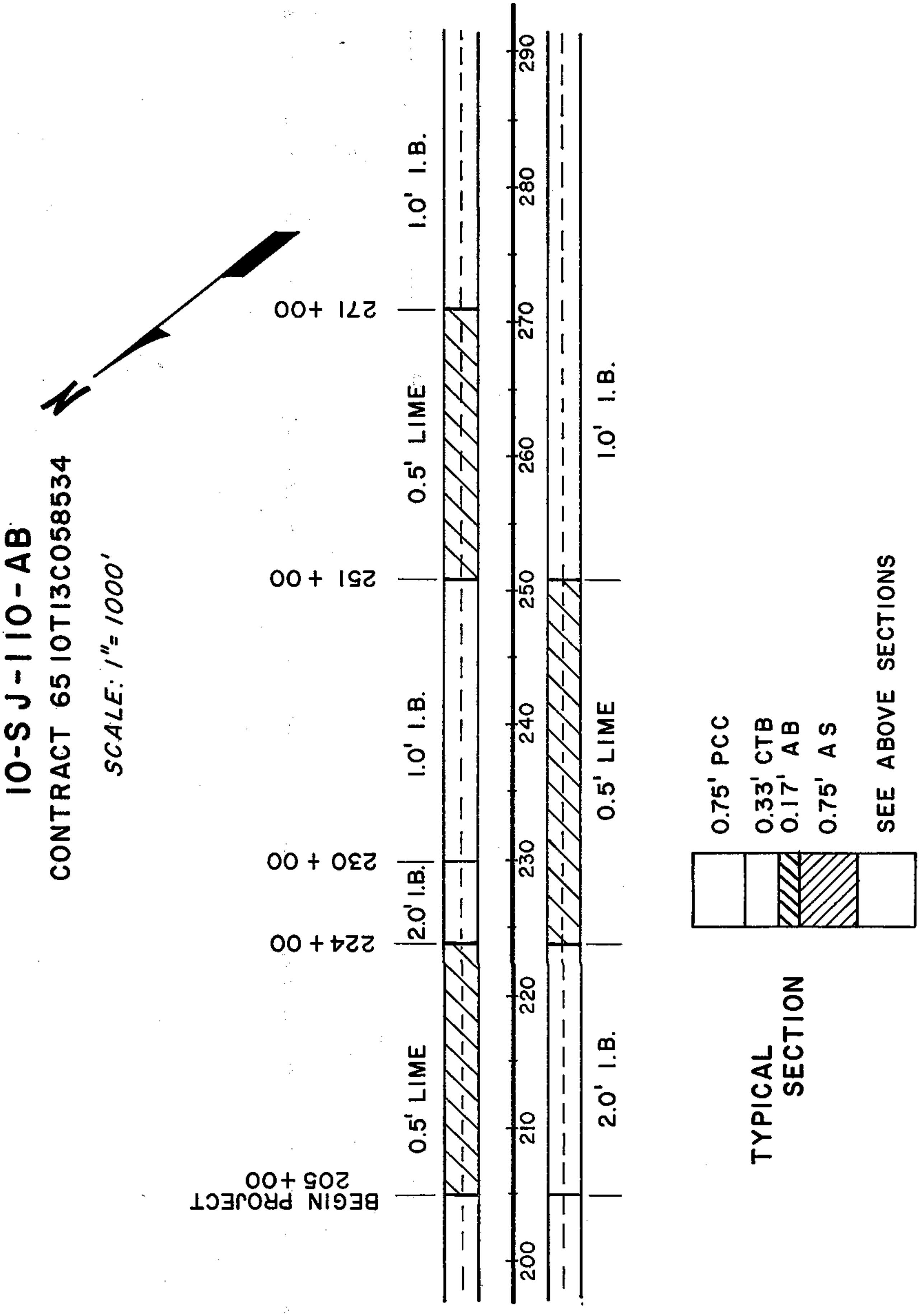
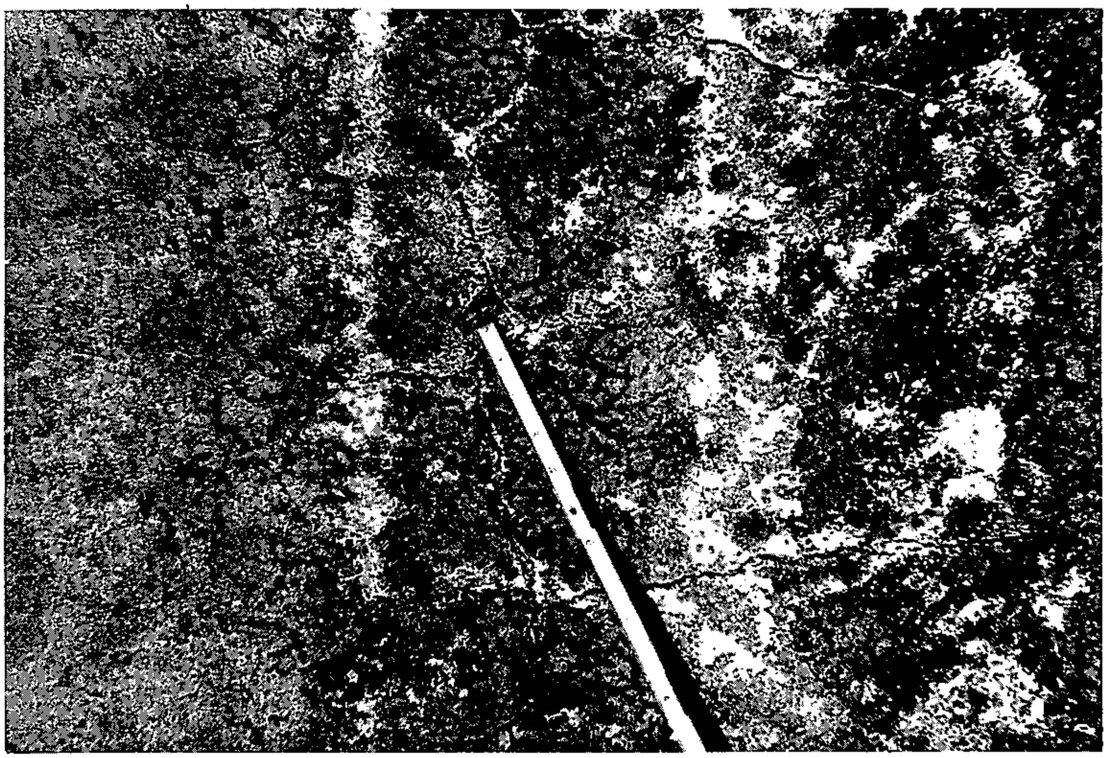
Figure 2



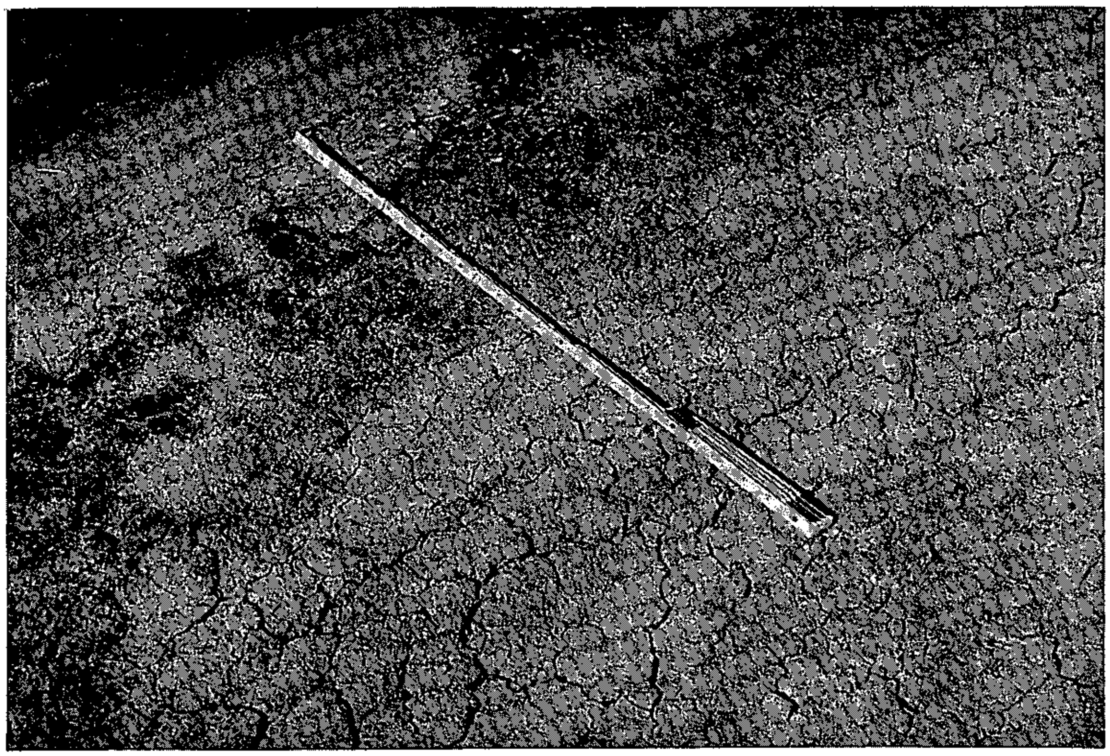
10-SJ-110-AB
CONTRACT 65 10T13C058534
SCALE: 1"= 1000'
N
BEGIN PROJECT 205+00
224+00
230+00
251+00
271+00
0.5' LIME
2.0' I.B.
1.0' I.B.
0.5' LIME
1.0' I.B.
2.0' I.B.
0.5' LIME
1.0' I.B.
200
210
220
230
240
250
260
270
280
290
TYPICAL SECTION
0.75' PCC
0.33' CTB
0.17' AB
0.75' AS
SEE ABOVE SECTIONS

FIGURE 3A



Crack pattern in the lime treated soil.

FIGURE 3B



Crack pattern in the untreated soil along the shoulder.

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Figure 4

SCHEMATIC SHOWING METAL TUBE INSTALLATION FOR NUCLEAR DETERMINATION OF MOISTURES

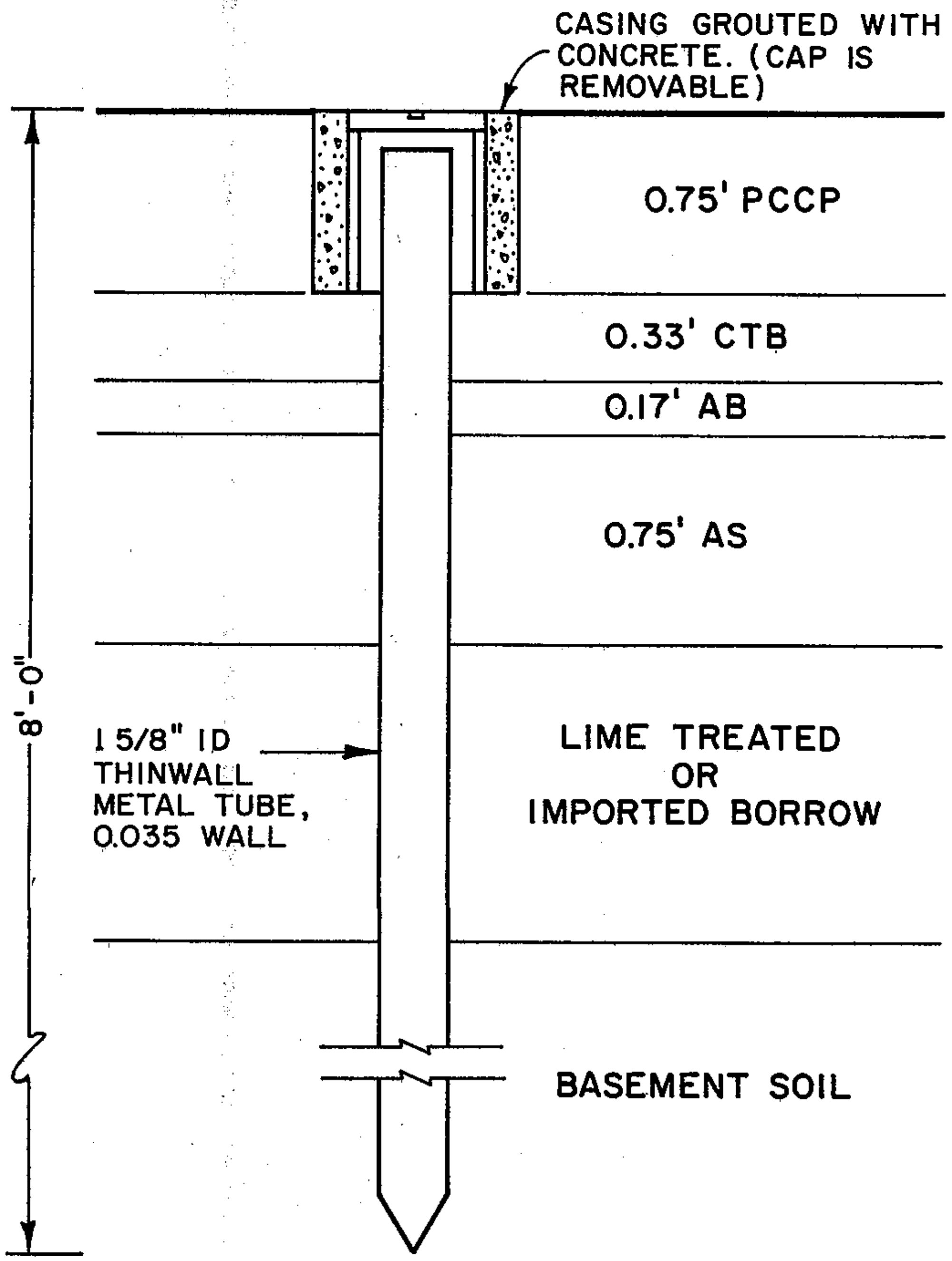

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Figure 5
NUCLEAR PROBE
FOR DETERMINING MOISTURE
(MODEL P-19)

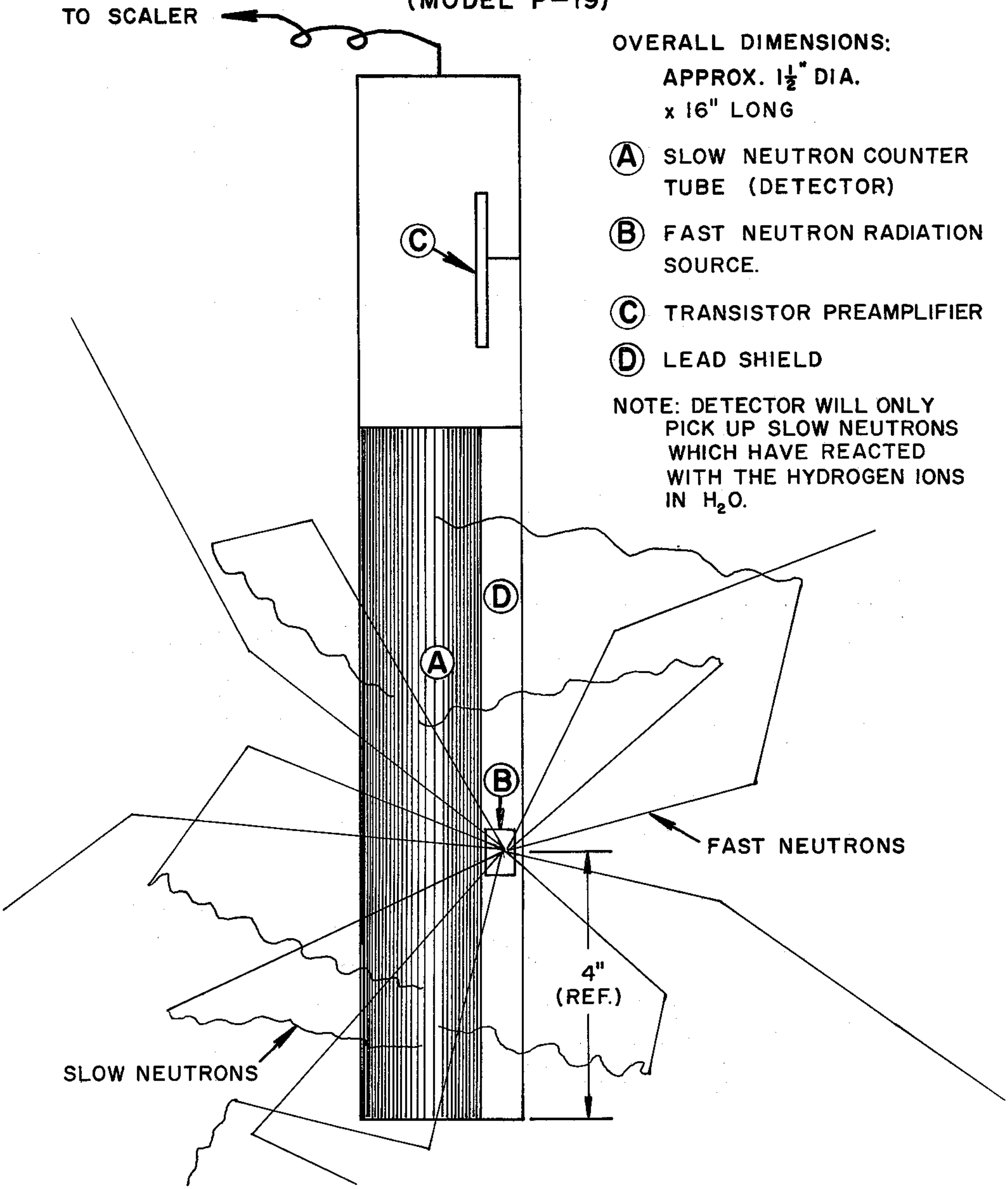

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Figure 6

AVERAGE PERCENT MOISTURE AT 4 LIME TREATED LOCATIONS

30" STRUCTURAL SECTION

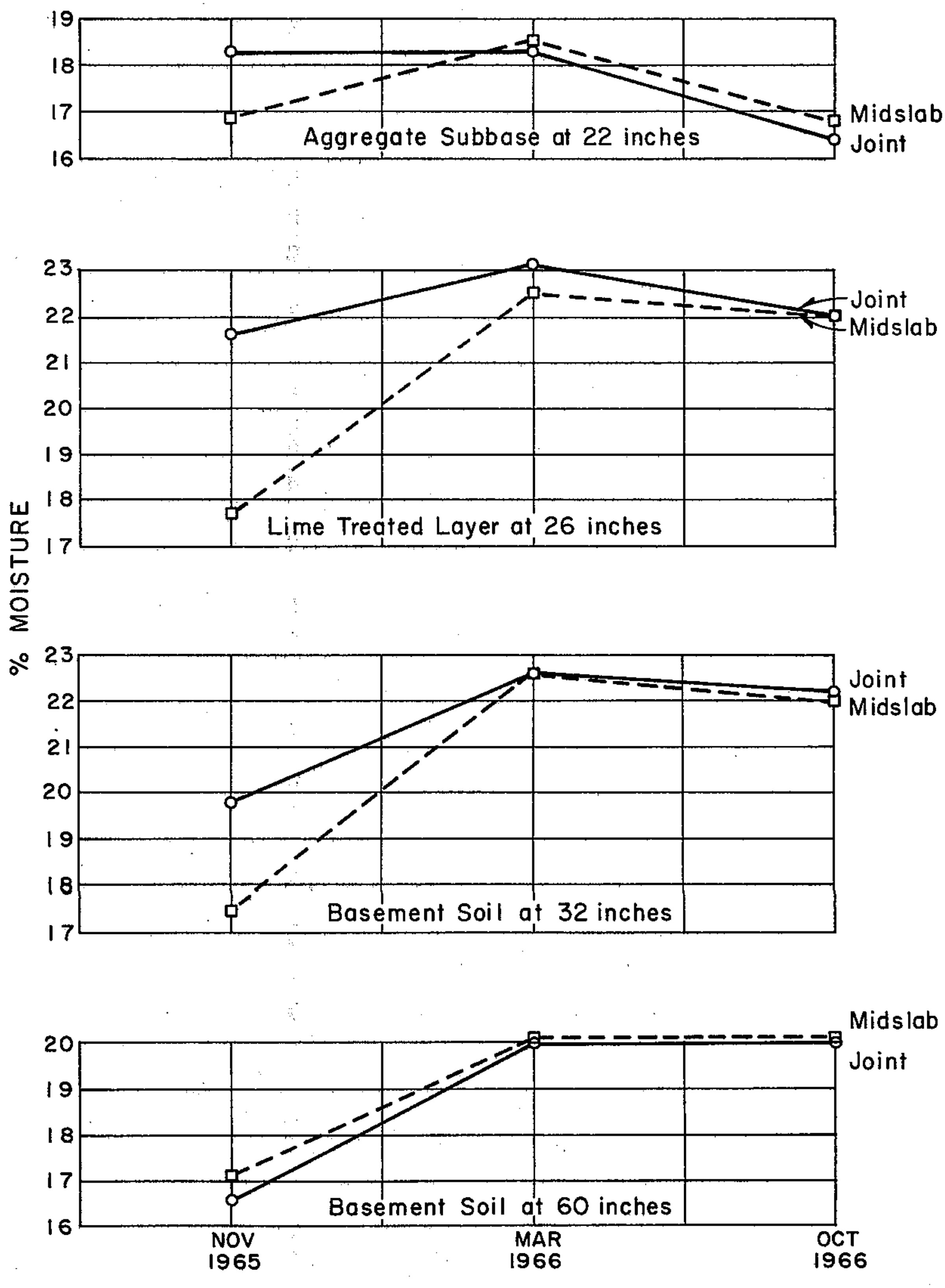

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Figure 7

AVERAGE PERCENT MOISTURE AT 2 UNTREATED LOCATIONS

3' STRUCTURAL SECTION
CONTROL SECTION

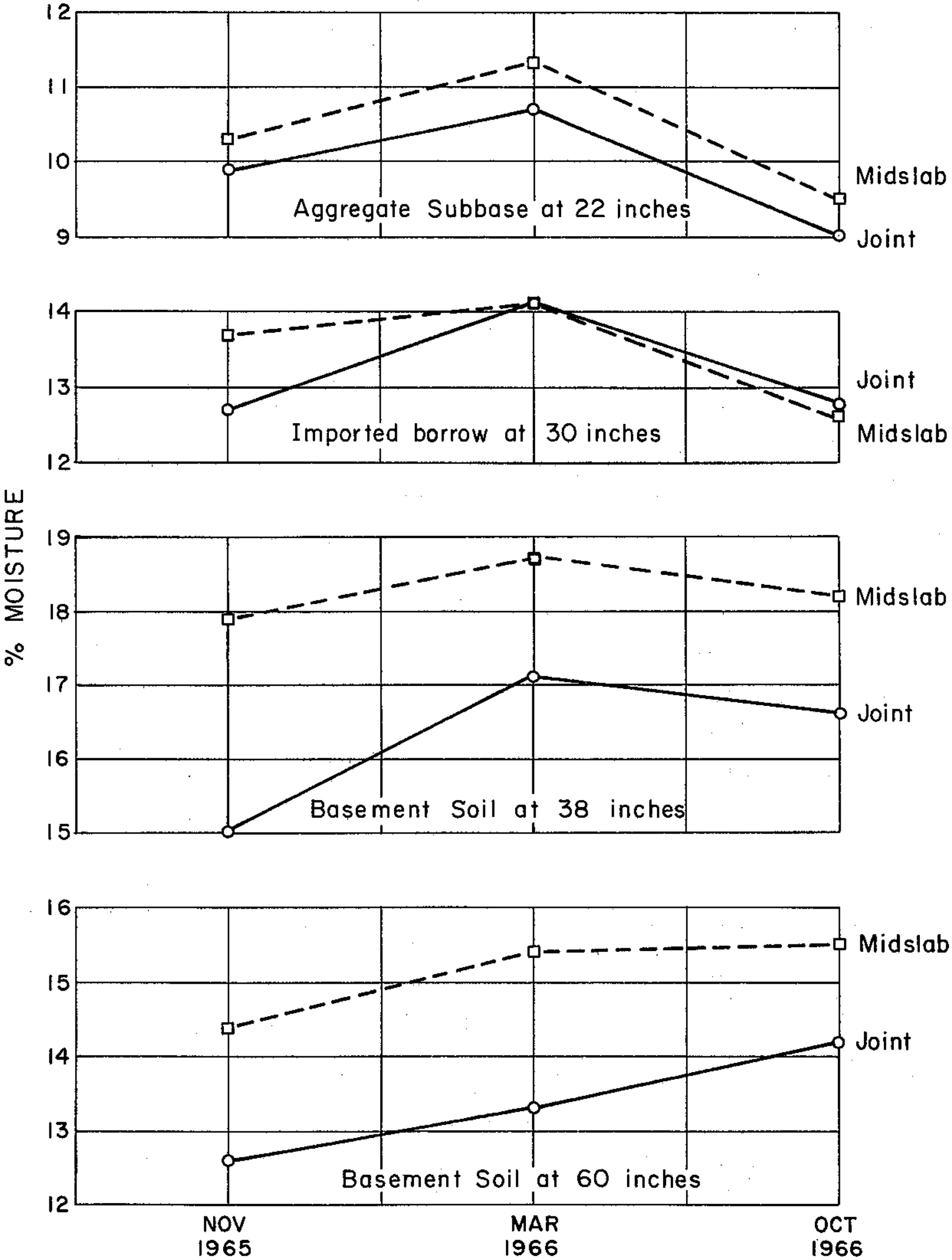

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Figure 8

AVERAGE PERCENT MOISTURE AT 2 UNTREATED LOCATIONS

4' CONTROL SECTION

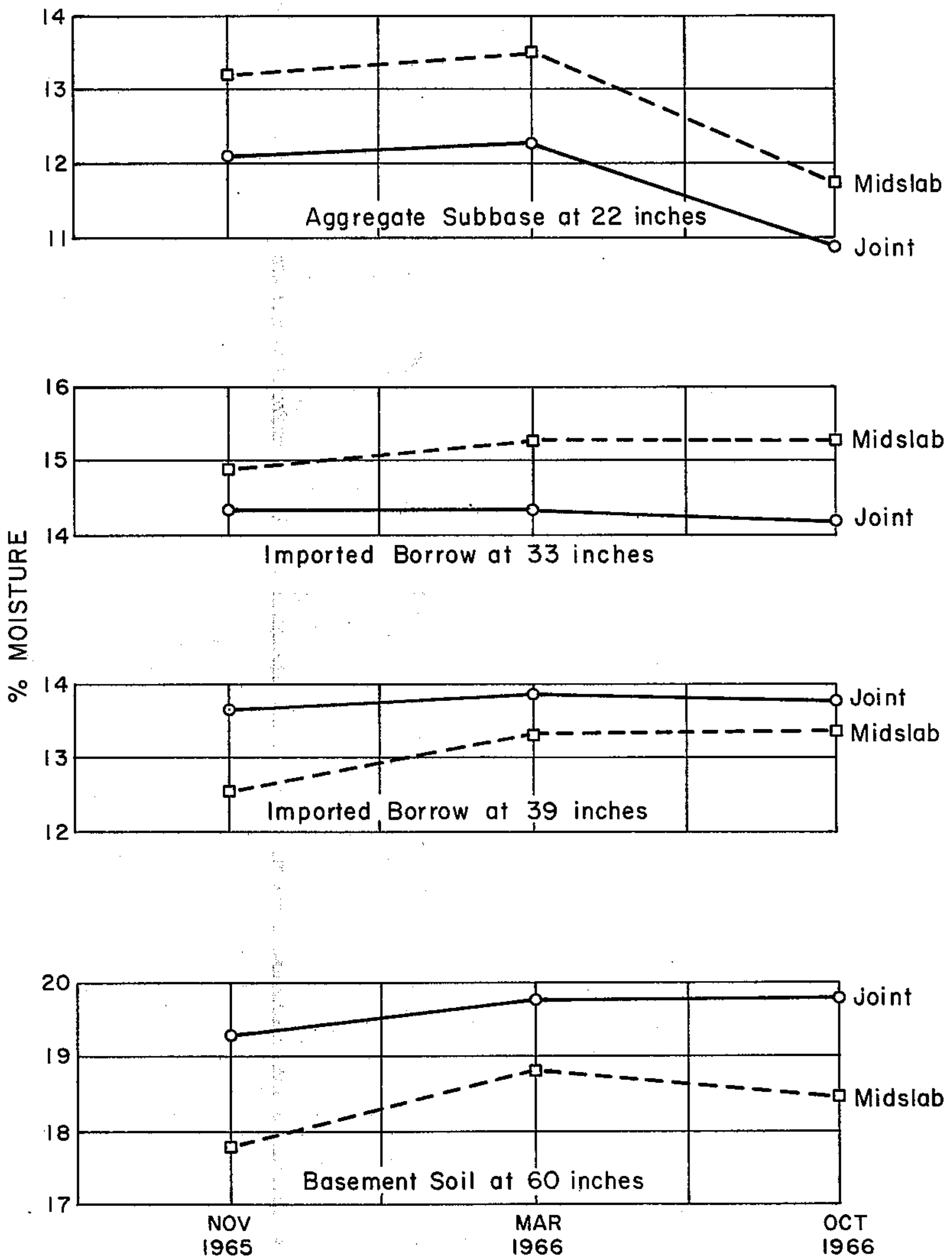

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Figure 9

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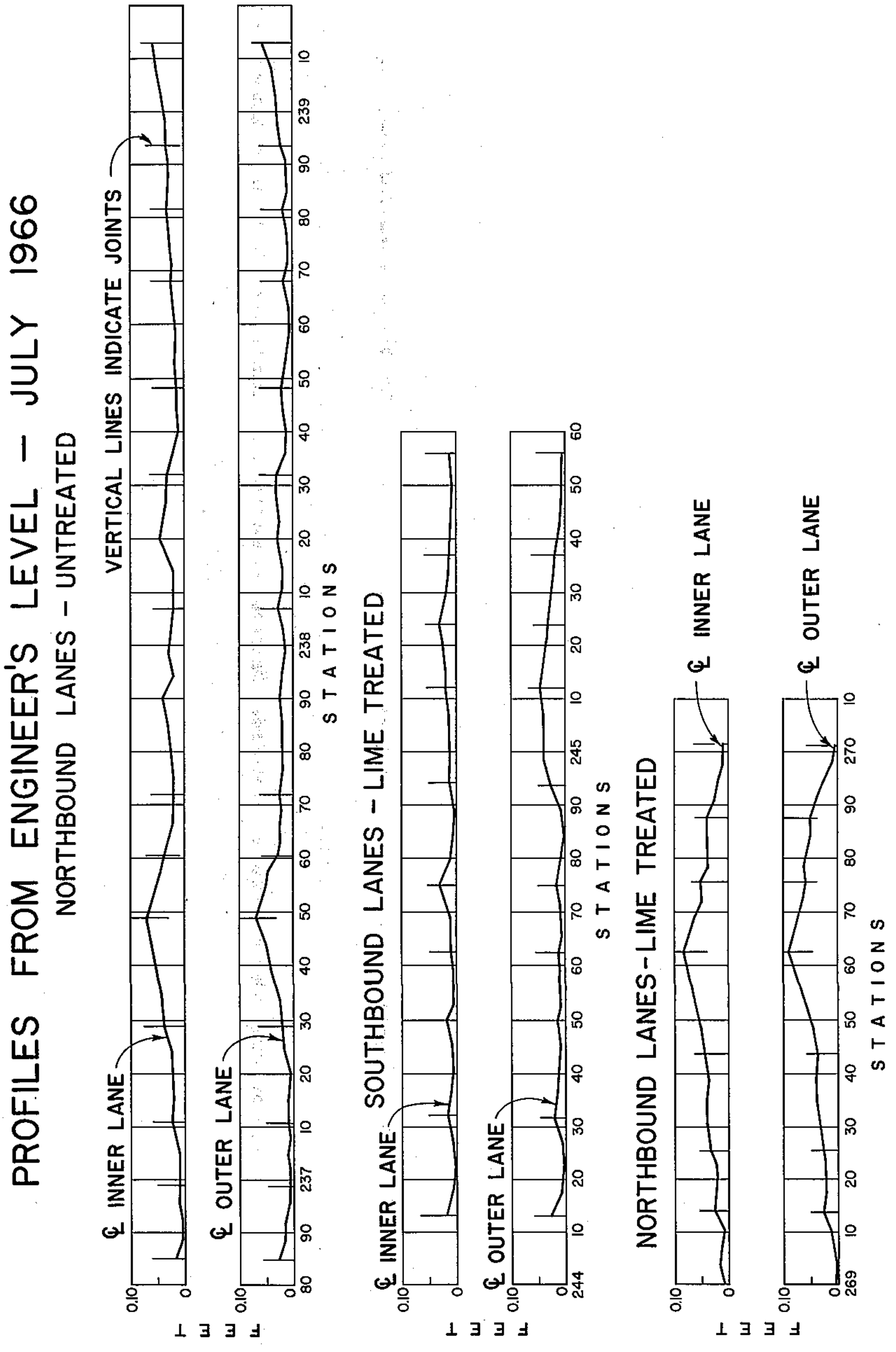
Figure 10



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PROFILES FROM ENGINEER'S LEVEL — JULY 1966

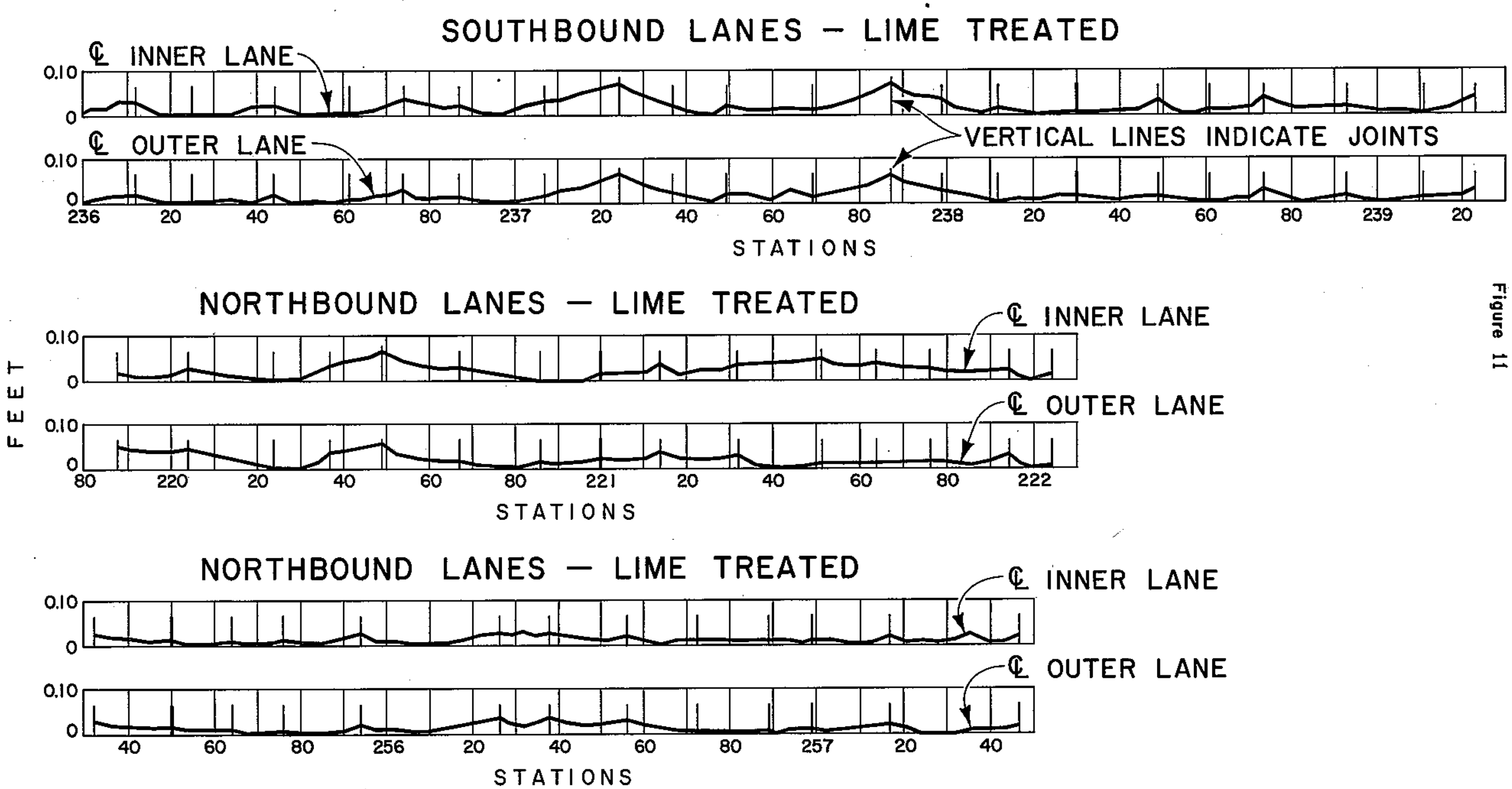

Figure 11

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